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Ultrashort Cationic Self-assembled Peptides/Peptidomimetic Nanomaterials

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Ultrashort Cationic Self-assembled Peptides for the Prevention of Medical Device Related Infection

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Outline

1. Medical devices- advantages+ disadvantages
2. What are ultrashort cationic peptides?
3. Role of ultrashort peptides in biofilm infections
4. Self-assembled peptides
5. Napthalene (Nap) self-assembled peptides
6. Conclusions of research to date

Medical Devices

- Major role in modern health-care settings
- Key problem= Biofilms and Infection
- Solutions:
 1. Antimicrobial impregnated coatings
 2. Antimicrobial releasing coatings
 3. Hydrogels

What are ultrashort cationic peptides? How are they antimicrobial?

- Ultrashort= 4-7 amino acids
- Cationic= net positive charge (+2)
- Peptides= biocompatible
- Antimicrobial= innate immune response
- Nanotechnology

Self-assembled peptides

- Higher- ordered structures
- pH, light, temperature, enzymes
- Hydrophobic: charge → Antimicrobial Activity
- Hydrophobic: Hydrophilic → Hydrogel Formation
- Biocompatible
- Biodegradable

Nap self-assembled peptides

- Nap= biocompatible and aromatic
- NapFF, NapFFKK, NapFFFKK, NapFFOO, NapFFK'K' (epislon variant)

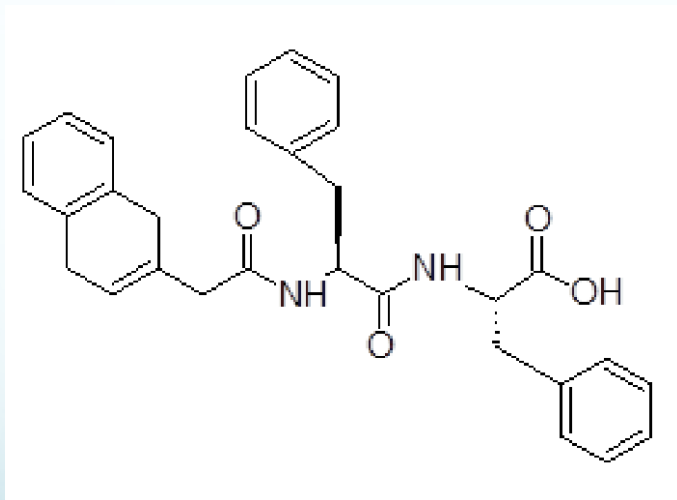


Figure 1. NapFF structure

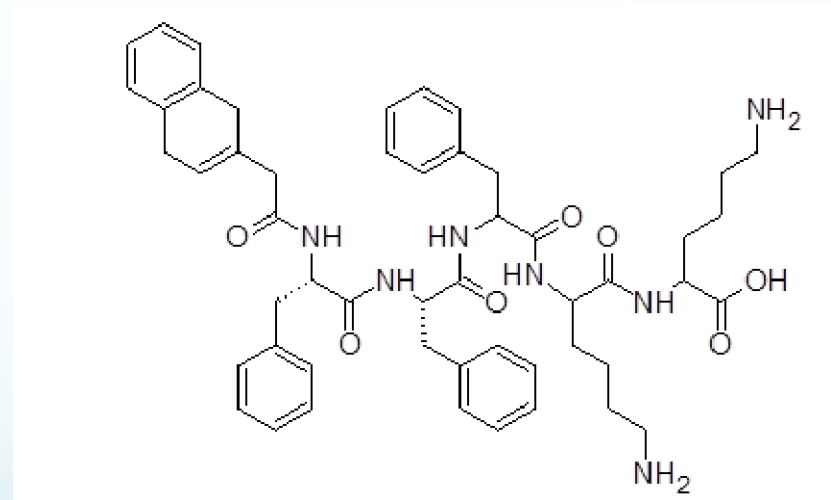


Figure 2. NapFFFKK structure

Nap self-assembled peptides



NapFFFKK

→ 1.5% w/v

→ 1% w/v

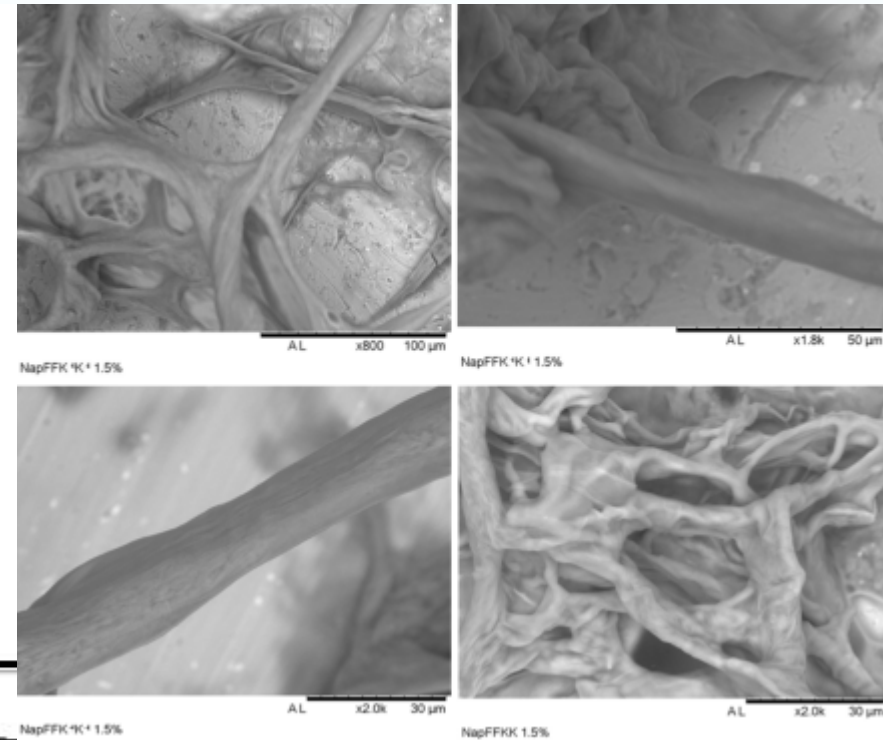


Figure 3. NapFFFKK Hydrogels

Figure 4. Cryo-SEM imaging NapFFFKK

TEM

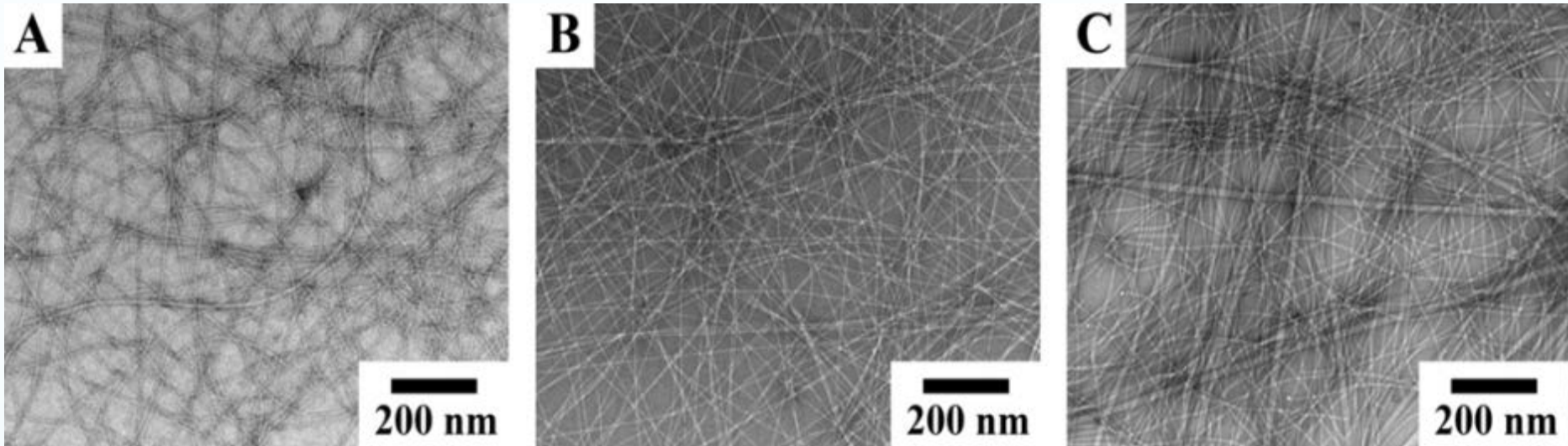


Figure 6. Transmission electron microscopy (TEM) images of (A) NapFFOO, (B) NapFFKK, (C) NapFFK'K', at a concentration of 1% w/v and pH of 7.4 in water.

Images obtained via collaboration with Prof Bing Xu's group, Brandeis University, Boston.

Antimicrobial Studies

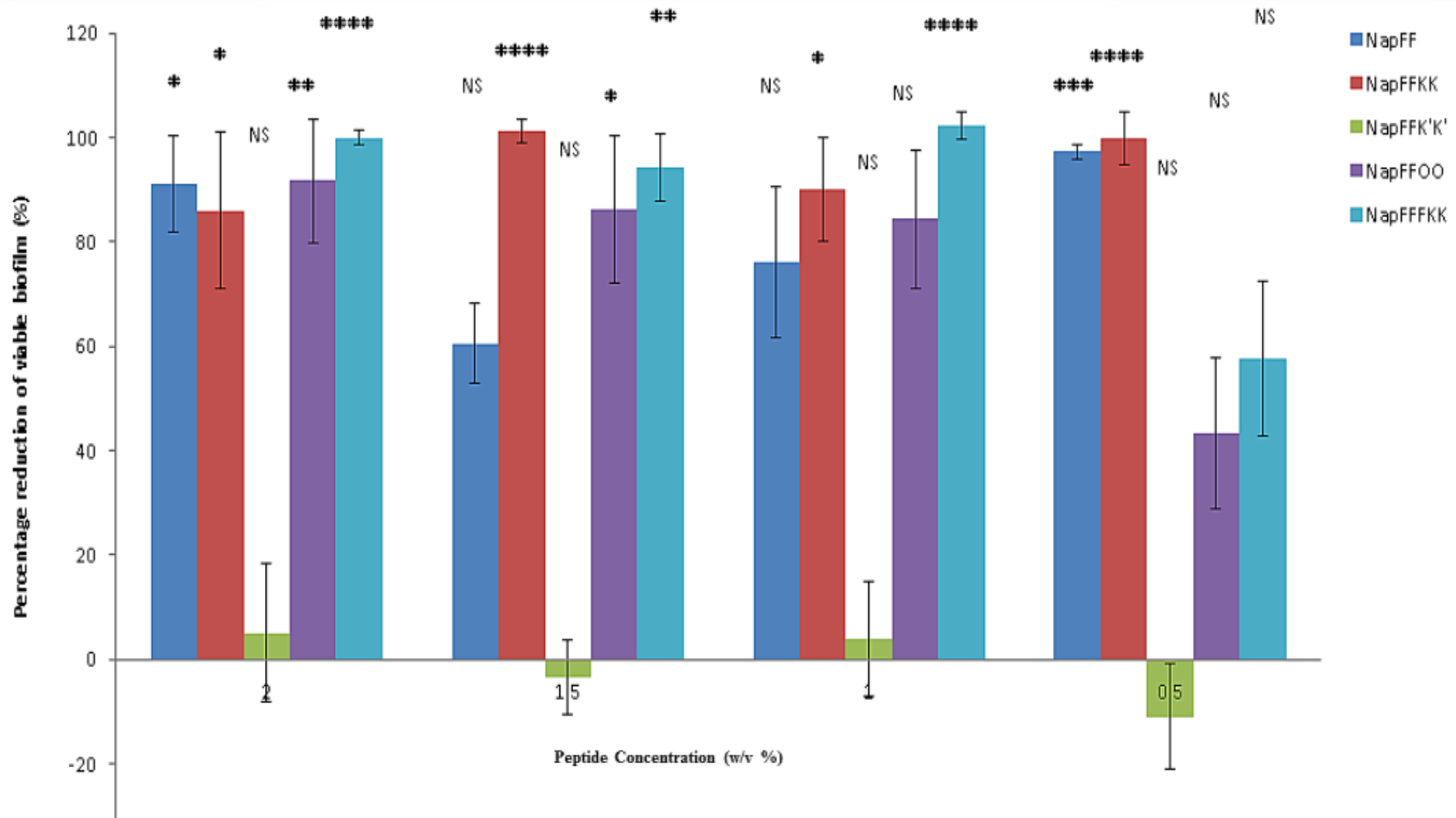


Figure 6. *Staphylococcus aureus* antimicrobial assay results

Conclusions

- Self-assembly in response to pH changes
- Cytotoxicity studies showed Nap peptides were selective to bacterial cells over mammalian cells
- Hydrogels were non-haemolytic
- Lysine peptides had greatest antimicrobial activity
- Peptides have potential to be conjugated to biomaterial surfaces
- *In vivo* antimicrobial activity is promising